METHODS AND COMPOSITIONS FOR TREATING MALE SEXUAL DYSFUNCTION

FIELD OF THE INVENTION

[0001] The invention relates to compositions that can ameliorate or prevent sexual disorders and are useful as a dietary supplement or medication. These compositions contain yeast cells obtainable by growth in electromagnetic fields with specific frequencies and field strengths.

BACKGROUND OF THE INVENTION

[0002] Impotence is one of the most common forms of male sexual dysfunction. It may be caused by diseases (e.g., diabetes) or certain medications. A variety of Western medicines and Chinese herbal medicines have been used to restore erectile function. However, these medicines are all less than satisfactory. There remains a need for an effective method for treating impotence.

SUMMARY OF THE INVENTION

[0003] This invention is based on the discovery that certain yeast cells can be activated by electromagnetic fields having specific frequencies and field strengths to treat sexual disorders. Compositions comprising these activated yeast cells can be used as a dietary supplement for improving sexual functions, e.g., for alleviating or preventing impotence.

[0004] This invention embraces a composition comprising a plurality of yeast cells that have been cultured in an alternating electric field having a frequency in the range of about 7900-13200 MHz (e.g., 7900-8000 or 12700-13200), and a field intensity in the range of about 240-500 mV/cm (e.g., 260-280, 290-320, 300-320, 310-340, 330-360, 350-380, 360-400, or 420-460 mV/cm). The yeast cells are cultured in the alternating electric field for a period of time sufficient to substantially increase the capability of said plurality of yeast cells to produce substances for treating sexual disorders (e.g., impotence). In one embodiment, the frequency and/or the field strength of the alternating electric field can be altered within the aforementioned ranges during said period of time. In other words, the yeast cells can be exposed to a series of electromagnetic fields. An exemplary period of time is about 40-180 hours (e.g., 60-168 hours).

[0005] Also included in this invention is a composition comprising a plurality of yeast cells that have been cultured under acidic conditions in an alternating electric field having a frequency in the range of about 12700-13200 MHz (e.g., 13000-13200 MHz) and a field strength in the range of about 240 to 420 mV/cm (e.g., 260-280 or 360-390 mV/cm). In one embodiment, the yeast cells are exposed to a series of electromagnetic fields. An exemplary period of time is about 30-100 hours (e.g., 35-60 hours).

[0006] Included in this invention are also methods of making the above compositions.

[0007] Yeast cells that can be included in this composition can be derived from parent strains publically available from the China General Microbiological Culture Collection Center ("CGMCC"), China Committee for Culture Collection of Microorganisms, Institute of Microbiology, Chinese Academy of Sciences, Haidian, P.O. BOX 2714, Beijing, 100080, China. Useful yeast species include, but are not limited to, *Saccharomyces cerevisiae*, *Saccharomyces carlsbergensis*, *Saccharomyces rouxii*, *Saccharomyces sake*, *Saccharomyces uvarum*, *Saccharomyces sp.*, *Schizosaccharomyces pombe*, *and Rhodotorula aurantiaca*. For instance, the yeast cells can be of the strain Saccharomyces cerevisiae Hansen AS2.502 or AS2.69, *Saccharomyces sp.* AS2.311, *Schizosaccharomyces pombe* Lindner AS2.994, *Saccharomyces sake* Yabe ACCC2045, *Saccharomyces uvarum*

Beijer IFFI1044, *Saccharomyces rouxii* Boutroux AS2.180, *Saccharomyces cerevisiae* Hansen Var. ellipsoideus AS2.612, *Saccharomyces carlsbergensis* Hansen AS2.377, or *Rhodotorula rubar* (Demme) Lodder AS2.282. Other useful yeast strains are illustrated in Table 1.

[0008] Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. Exemplary methods and materials are described below, although methods and materials similar or equivalent to those described herein can also be used in the practice or testing of the present invention. All publications and other references mentioned herein are incorporated by reference in their entirety. In case of conflict, the present specification, including definitions, will control. The materials, methods, and examples are illustrative only and not intended to be limiting. Throughout this specification and claims, the word "comprise," or variations such as "comprises" or "comprising" will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

[0009] Other features and advantages of the invention will be apparent from the following detailed description, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Fig. 1 is a schematic diagram showing an exemplary apparatus for activating yeast cells using electromagnetic fields. 1: yeast culture; 2: container; 3: power supply.

[0011] Fig. 2 is a schematic diagram showing an exemplary apparatus for making yeast compositions of the invention. The apparatus comprises a signal generator (such as models 83721B and 83741A manufactured by HP) and interconnected containers A, B and C.

DETAILED DESCRIPTION OF THE INVENTION

[0012] This invention is based on the discovery that certain yeast strains can be activated by electromagnetic fields ("EMF") having specific frequencies and field strengths to produce agents useful in treating sexual disorders, e.g., impotence.

Yeast compositions containing activated yeast cells can be used as medication, or as a dietary supplement in the form of health drinks or dietary pills.

[0013] In certain embodiments, the yeast compositions of this invention stimulate the secretion of male hormones, e.g., testosterone. In other embodiments, the yeast compositions decrease or inhibit the effects of certain chemicals/drugs in the body that contribute to male sexual dysfunction (e.g., impotence). In further embodiments, the yeast compositions alleviate male sexual dysfunction (e.g., impotence) caused by diabetes.

[0014] Since the activated yeast cells contained in these yeast compositions have been cultured to endure acidic conditions (pH 2.5-4.2), the compositions are stable in the stomach and can pass on to the intestines. Once in the intestines, the yeast cells are ruptured by various digestive enzymes, and the bioactive agents are released and readily absorbed.

I. <u>Yeast Strains Useful In The Invention</u>

[0015] The types of yeasts useful in this invention include, but are not limited to, yeasts of the genera of *Saccharomyces*, *Rhodotorula*, and *Schizosaccharomyces*.

[0016] Exemplary species within the above-listed genera include, but are not limited to, the species illustrated in Table 1. Yeast strains useful in this invention can be obtained from laboratory cultures, or from publically accessible culture depositories, such as CGMCC and the American Type Culture Collection, 10801 University Boulevard, Manassas, VA 20110-2209. Non-limiting examples of useful strains (with the accession numbers of CGMCC) are *Saccharomyces cerevisiae* Hansen AS2.502 and AS2.69, *Saccharomyces sp.* AS2.311, *Schizosaccharomyces pombe* Lindner AS2.994, *Saccharomyces sake* Yabe ACCC2045, *Saccharomyces uvarum* Beijer IFFI1044, *Saccharomyces rouxii* Boutroux AS2.180, *Saccharomyces cerevisiae* Hansen Var. ellipsoideus AS2.612, *Saccharomyces carlsbergensis* Hansen AS2.377, and *Rhodotorula rubar* (Demme) Lodder AS2.282. Other non-limiting examples of useful strains are listed in Table 1. In general, yeast strains preferred in this invention are those used for fermentation in the food and wine industries. As a result, compositions containing these yeast cells are safe for human consumption.

[0017] The preparation of the yeast compositions of this invention is not limited to starting with a pure strain of yeast. A yeast composition of the invention may be produced by culturing a mixture of yeast cells of different species or strains.

Table 1 Exemplary Yeast Strains

Saccharomyces cerevisiae Hansen				
ACCC2034	ACCC2035	ACCC2036	ACCC2037	ACCC2038
ACCC2039	ACCC2040	ACCC2041	ACCC2042	AS2. 1
AS2. 4	AS2. 11	AS2. 14	AS2. 16	AS2. 56
AS2. 69	AS2. 70	AS2. 93	AS2. 98	AS2. 101
AS2. 109	AS2. 110	AS2. 112	AS2. 139	AS2. 173
AS2. 174	AS2. 182	AS2. 196	AS2. 242	AS2. 336
AS2. 346	AS2. 369	AS2. 374	AS2. 375	AS2. 379
AS2. 380	AS2. 382	AS2. 390	AS2. 393	AS2. 395
AS2. 396	AS2. 397	AS2. 398	AS2. 399	AS2. 400
AS2. 406	AS2. 408	AS2. 409	AS2. 413	AS2. 414
AS2. 415	AS2. 416	AS2. 422	AS2. 423	AS2. 430
AS2. 431	AS2. 432	AS2. 451	AS2. 452	AS2. 453
AS2. 458	AS2. 460	AS2. 463	AS2. 467	AS2. 486
AS2. 501	AS2. 502	AS2. 503	AS2. 504	AS2. 516
AS2. 535	AS2. 536	AS2. 558	AS2. 560	AS2. 561
AS2. 562	AS2. 576	AS2. 593	AS2. 594	AS2. 614
AS2. 620	AS2. 628	AS2. 631	AS2. 666	AS2. 982
AS2. 1190	AS2. 1364	AS2. 1396	IFFI1001	IFFI1002
IFFI1005	IFFI1006	IFFI1008	IFFI1009	IFFI1010
IFFI1012	IFFI1021	IFFI1027	IFFI1037	IFFI1042
IFFI1043	IFFI1045	IFFI1048	IFFI1049	IFFI1050
IFFI1052	IFFI1059	IFFI1060	IFFI1062	IFFI1063
IFFI1202	IFFI1203	IFFI1206	IFFI1209	IFFI1210
IFFI1211	IFFI1212	IFFI1213	IFFI1214	IFFI1215
IFFI1220	IFFI1221	IFFI1224	IFFI1247	IFFI1248
IFFI1251	IFFI1270	IFFI1277	IFFI1287	IFFI1289
IFFI1290	IFFI1291	IFFI1292	IFFI1293	IFFI1297
IFFI1300	IFFI1301	IFFI1302	IFFI1307	IFFI1308
IFFI1309	IFFI1310	IFFI1311	IFFI1331	IFFI1335

IFFI1336	IFFI1337	IFFI1338	IFFI1339	IFFI1340
IFFI1345	IFFI1348	IFFI1396	IFFI1397	IFFI1399
IFFI1411	IFFI1413	IFFI1441	IFFI1443	
Saccharomyces cerevisiae Hansen Var. ellipsoideus (Hansen) Dekker				
ACCC2043	AS2.2	AS2.3	AS2.8	AS2.53
AS2.163	AS2.168	AS2.483	AS2.541	AS2.559
AS2.606	AS2.607	AS2.611	AS2.612	
Saccharomyces chevalieri Guilliermond				
AS2.131	AS2.213			
Saccharomyces delbrueckii				
AS2.285				
Saccharomyces delbrueckii Lindner ver. mongolicus (Saito) Lodder et van Rij				
AS2.209	AS2.1157			
Saccharomyces exiguous Hansen				
AS2.349	AS2.1158			
Saccharomyces fermentati (Saito) Lodder et van Rij				
AS2.286	AS2.343			
Saccharomyces logos van laer et Denamur ex Jorgensen				
AS2.156	AS2.327	AS2.335		
Saccharomyces mellis (Fabian et Quinet) Lodder et kreger van Rij				
AS2.195				
Saccharomyces mellis Microellipsoides Osterwalder				
AS2.699				
Saccharomyces oviformis Osteralder				

AS2.100
Saccharomyces rosei (Guilliermond) Lodder et Kreger van Rij
AS2.287
Saccharomyces rouxii Boutroux
AS2.178 AS2.180 AS2.370 AS2.371
Saccharomyces sake Yabe
ACCC2045
Candida arborea
AS2.566
Candida lambica (Lindner et Genoud) van. Uden et Buckley
AS2.1182
Candida krusei (Castellani) Berkhout
AS2.1045
Candida lipolytica (Harrison) Diddens et Lodder
AS2.1207 AS2.1216 AS2.1220 AS2.1379 AS2.1398 AS2.1399 AS2.1400
Candida parapsilosis (Ashford) Langeron et Talice Var. intermedia Van Rij et Verona
AS2.491
Candida parapsilosis (Ashford) Langeron et Talice
AS2.590
Candida pulcherrima (Lindner) Windisch
AS2.492

Candida rugousa (Anderson) Diddens et Lodder				
AS2.511	AS2.1367	AS2.1369	AS2.1372	AS2.1373
AS2.1377	AS2.1378	AS2.1384		
Candida tropicalis (Castellani) Berkhout				
ACCC2004	ACCC2005	ACCC2006	AS2.164	AS2.402
AS2.564	AS2.565	AS2.567	AS2.568	AS2.617
AS2.637	AS2.1387	AS2.1397		
Candida utilis Henneberg Lodder et Kreger Van Rij				
AS2.120	AS2.281	AS2.1180		
Crebrothecium ashbyii (Guillermond) Routein (*Eremothecium ashbyii* Guilliermond)				
AS2.481	AS2.482	AS2.1197		
Geotrichum candidum Link				
ACCC2016	AS2.361	AS2.498	AS2.616	AS2.1035
AS2.1062	AS2.1080	AS2.1132	AS2.1175	AS2.1183
Hansenula anomala (Hansen)H et P sydow				
ACCC2018	AS2.294	AS2.295	AS2.296	AS2.297
AS2.298	AS2.299	AS2.300	AS2.302	AS2.338
AS2.339	AS2.340	AS2.341	AS2.470	AS2.592
AS2.641	AS2.642	AS2.782	AS2.635	AS2.794
Hansenula arabitolgens Fang				
AS2.887				
Hansenula jadinii (A. et R Sartory Weill et Meyer) Wickerham				
ACCC2019				
Hansenula saturnus (Klocker) H et P sydow				

ACCC2020				
Hansenula schneggii (Weber) Dekker				
AS2.304				
Hansenula subpelliculosa Bedford				
AS2.740	AS2.760	AS2.761	AS2.770	AS2.783
AS2.790	AS2.798	AS2.866		
Kloeckera apiculata (Reess emend. Klocker) Janke				
ACCC2022	ACCC2023	AS2.197	AS2.496	AS2.714
ACCC2021	AS2.711			
Lipomycess starkeyi Lodder et van Rij				
AS2.1390	ACCC2024			
Pichia farinosa (Lindner) Hansen				
ACCC2025	ACCC2026	AS2.86	AS2.87	AS2.705
AS2.803				
Pichia membranaefaciens Hansen				
ACCC2027	AS2.89	AS2.661	AS2.1039	
Rhodosporidium toruloides Banno				
ACCC2028				
Rhodotorula glutinis (Fresenius) Harrison				
AS2.2029	AS2.280	ACCC2030	AS2.102	AS2.107
AS2.278	AS2.499	AS2.694	AS2.703	AS2.704
AS2.1146				
Rhodotorula minuta (Saito) Harrison				
AS2.277				

Rhodotorula rubar (Demme) Lodder				
AS2.21	AS2.22	AS2.103	AS2.105	AS2.108
AS2.140	AS2.166	AS2.167	AS2.272	AS2.279
AS2.282	ACCC2031			
Rhodotorula aurantiaca (Saito) Lodder				
AS2.102	AS2.107	AS2.278	AS2.499	AS2.694
AS2.703	AS2.1146			
Saccharomyces carlsbergensis Hansen				
AS2.113	ACCC2032	ACCC2033	AS2.312	AS2.116
AS2.118	AS2.121	AS2.132	AS2.162	AS2.189
AS2.200	AS2.216	AS2.265	AS2.377	AS2.417
AS2.420	AS2.440	AS2.441	AS2.443	AS2.444
AS2.459	AS2.595	AS2.605	AS2.638	AS2.742
AS2.745	AS2.748	AS2.1042		
Saccharomyces uvarum Beijer				
IFFI1023	IFFI1032	IFFI1036	IFFI1044	IFFI1072
IFFI1205	IFFI1207			
Saccharomyces willianus Saccardo				
AS2.5 AS2.7	AS2.119	AS2.152	AS2.293	
AS2.381	AS2.392	AS2.434	AS2.614	AS2.1189
Saccharomyces sp.				
AS2.311				
Saccharomycodes ludwigii Hansen				
ACCC2044	AS2.243	AS2.508		
Saccharomycodes sinenses Yue				
AS2.1395				

Schizosaccharomyces octosporus Beijerinck				
ACCC2046	AS2.1148			
Schizosaccharomyces pombe Lindner				
ACCC2047	ACCC2048	AS2.214	AS2.248	AS2.249
AS2.255	AS2.257	AS2.259	AS2.260	AS2.274
AS2.994	AS2.1043	AS2.1149	AS2.1178	IFFI1056
Sporobolomyces roseus Kluyver et van Niel				
ACCC2049	ACCC2050	AS2.19	AS2.962	AS2.1036
ACCC2051	AS2.261	AS2.262		
Torulopsis candida (Saito) Lodder				
AS2.270	ACCC2052			
Torulopsis famta (Harrison) Lodder et van Rij				
ACCC2053	AS2.685			
Torulopsis globosa (Olson et Hammer) Lodder et van Rij				
ACCC2054	AS2.202			
Torulopsis inconspicua Lodder et Kreger van Rij				
AS2.75				
Trichosporon behrendii Lodder et Kreger van Rij				
ACCC2056	AS2.1193			
Trichosporon capitatum Diddens et Lodder				
ACCC2056	AS2.1385			
Trichosporon cutaneum (de Beurm et al.) Ota				
ACCC2057	AS2.25	AS2.570	AS2.571	AS2.1374

Wickerhamia fluorescens (Soneda) Soneda
ACCC2058 AS2.1388

II. Application of Electromagnetic Fields

[0018] An electromagnetic field useful in this invention can be generated and applied by various means well known in the art. For instance, the EMF can be generated by applying an alternating electric field or an oscillating magnetic field.

[0019] Alternating electric fields can be applied to cell cultures through electrodes in direct contact with the culture medium, or through electromagnetic induction. See, e.g., Fig. 1. Relatively high electric fields in the medium can be generated using a method in which the electrodes are in contact with the medium. Care must be taken to prevent electrolysis at the electrodes from introducing undesired ions into the culture and to prevent contact resistance, bubbles, or other features of electrolysis from dropping the field level below that intended. Electrodes should be matched to their environment, for example, using Ag-AgCl electrodes in solutions rich in chloride ions, and run at as low a voltage as possible. For general review, see Goodman et al., *Effects of EMF on Molecules and Cells*, International Review of Cytology, A Survey of Cell Biology, Vol. 158, Academic Press, 1995.

[0020] The EMFs useful in this invention can also be generated by applying an oscillating magnetic field. An oscillating magnetic field can be generated by oscillating electric currents going through Helmholtz coils. Such a magnetic field in turn induces an electric field.

[0021] The frequencies of EMFs useful in this invention range from about 7900 MHz to 13200 MHz (e.g., 7900-8000 or 12700-13200). Exemplary frequencies include 7963, 7975, 12744, 13092, and 13123 MHz. The field strength of the electric field useful in this invention ranges from about 240-500 mV/cm (e.g., 260-280, 290-320, 300-320, 310-340, 330-360, 350-380, 360-390, or 420-460 mV/cm). Exemplary field strengths include 266, 272, 307, 318, 322, 343, 348, 367, 375, 397, and 438 mV/cm.

[0022] When a series of EMFs are applied to a yeast culture, the yeast culture can remain in the same container while the same set of EMF generator and emitters is used to change the frequency and/or field strength. The EMFs in the series can each have a different frequency or a different field strength; or a different frequency and a different field strength. Such frequencies and field strengths are preferably within the above-described ranges. Although any practical number of EMFs can be used in a series, it may be preferred that the yeast culture be exposed to a total of 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, or more EMFs in a series. In one embodiment, the yeast culture is exposed to a series of EMFs, wherein the frequency of the electric field is alternated in the range of about 7900-8000, 12700-12800, and 13050-13200 MHz.

[0023] Although the yeast cells can be activated after even a few hours of culturing in the presence of an EMF, it may be preferred that the activated yeast cells be allowed to multiply and grow in the presence of the EMF(s) for a total of 40-180 hours.

[0024] Fig. 1 illustrates an exemplary apparatus for generating alternating electric fields. An electric field of a desired frequency and intensity can be generated by an AC source (3) capable of generating an alternating electric field, preferably in a sinusoidal wave form, in the frequency range of 5 to 20,000 MHz. Signal generators capable of generating signals with a narrower frequency range can also be used. If desired, a signal amplifier can also be used to increase the output. The culture container (2) can be made from a non-conductive material, e.g., glass, plastic or ceramic. The cable connecting the culture container (2) and the signal generator (3) is preferably a high frequency coaxial cable with a transmission frequency of at least 30 GHz.

[0025] The alternating electric field can be applied to the culture by a variety of means, including placing the yeast culture (1) in close proximity to the signal emitters such as a metal wire or tube capable of transmitting EMFs. The metal wire or tube can be made of red copper, and be placed inside the container (2), reaching as deep as 3-30 cm. For example, if the fluid in the container (2) has a depth of 15-20 cm, 20-30 cm, 30-50 cm, 50-70 cm, 70-100 cm, 100-150 cm or 150-200 cm, the metal wire can be 3-5 cm, 5-7 cm, 7-10 cm, 10-15 cm, 15-20 cm,

20-30 cm, and 25-30 cm from the bottom of the container (2), respectively. The number of metal wires/tubes used can be from 1 to 10 (e.g., 2 to 3). It is recommended, though not mandated, that for a culture having a volume up to 10 L, metal wires/tubes having a diameter of 0.5 to 2 mm be used. For a culture having a volume of 10-100 L, metal wires/tubes having a diameter of 3 to 5 mm can be used. For a culture having a volume of 100-1000 L, metal wires/tubes having a diameter of 6 to 15 mm can be used. For a culture having a volume greater than 1000 L, metal wires/tubes having a diameter of 20-25 mm can be used.

[0026] In one embodiment, the electric field is applied by electrodes submerged in the culture (1). In this embodiment, one of the electrodes can be a metal plate placed on the bottom of the container (2), and the other electrode can comprise a plurality of electrode wires evenly distributed in the culture (1) so as to achieve even distribution of the electric field energy.

III. Culture Media

[0027] Culture media useful in this invention contain sources of nutrients that can be assimilated by yeast cells. Complex carbon-containing substances in a suitable form (e.g., carbohydrates such as sucrose, glucose, dextrose, maltose, xylose, cellulose, starch, etc.) can be the carbon sources for yeast cells. The exact quantity of the carbon sources can be adjusted in accordance with the other ingredients of the medium. In general, the amount of carbohydrates varies between about 1% and 10% by weight of the medium and preferably between about 1 % and 5%, and most preferably about 2%. These carbon sources can be used individually or in combination. Amino acid-containing substances such as beef extract and peptone can also be added. In general, the amount of amino acid containing substances varies between about 0.1% and 1% by weight of the medium and preferably between about 0.1% and 0.5%. Among the inorganic salts which can be added to a culture medium are the customary salts capable of yielding sodium, potassium, calcium, phosphate, sulfate, carbonate, and like ions. Non-limiting examples of nutrient inorganic salts are $(NH_4)_2HPO_4$, $CaCO_3$, KH_2PO_4, K_2HPO_4, $MgSO_4$, NaCl, and $CaSO_4$.

IV. Electromagnetic Activation of Yeast Cells

[0028] To activate or enhance the ability of yeast cells to produce agents useful for treating sexual disorders (e.g., impotence), these cells can be cultured in an appropriate medium under sterile conditions at 20-35°C (e.g., 28-32°C) for a sufficient amount of time (e.g., 60-168 hours) in an alternating electric field or a series of alternating electric fields as described above.

[0029] An exemplary set-up of the culture process is depicted in Fig. 1 (see above). An exemplary culture medium contains the following per 950 ml of sterilized water: 6 g of sucrose, 12 g of mannitol, 90 μg of Vitamin D, 60 μg of Vitamin E, 40 μg of Vitamin H, 60 mg of Vitamin B_6, 50 ml of fetal bovine serum, 0.2 g of KH_2PO_4, 0.25 g of $MgSO_4{\bullet}7H_2O$, 0.3 g of NaCl, 0.2 g of $CaSO_4{\bullet}2H_2O$, 4 g of $CaCO_3{\bullet}5H_2O$, and 2.5 g of peptone. Yeast cells of the desired strain(s) are then added to the culture medium to form a mixture containing $1X10^8$ cells per 1000 ml of culture medium. The yeast cells can be of any of the strains listed in Table 1. The mixture is then added to the apparatus shown in Fig. 1.

[0030] The activation process of the yeast cells involves the following steps: (1) maintaining the temperature of the activation apparatus at 24-33°C (e.g., 28-32°C), and culturing the yeast cells for 24-30 hours (e.g., 28 hours); (2) applying an alternating electric field having a frequency of 7963 MHz and a field strength of 260-280 mV/cm (e.g., 272 mV/cm) for 12-18 hours (e.g., 16 hours); (3) then applying an alternating electric field having a frequency of 7975 MHz and a field strength of 310-340 mV/cm (e.g., 322 mV/cm) for 32-38 hours (e.g., 36 hours); (4) then applying an alternating electric field having a frequency of 12744 MHz and a field strength of 330-360 mV/cm (e.g., 343 mV/cm) for 32-38 hours (e.g., 36 hours); (5) then applying an alternating electric field having a frequency of 13092 MHz and a field strength of 350-380 mV/cm (e.g., 367 mV/cm) for 32-38 hours (e.g., 36 hours); and (6) then applying an alternating electric field having a frequency of 13123 MHz and a field strength of 290-320 mV/cm (e.g., 307 mV/cm) for 12-18 hours (e.g., 16 hours). The activated yeast cells are then recovered from the culture medium by various methods known in the art, dried (e.g., by lyophilization) and stored at 4°C. Preferably, the concentration of the dried yeast cells is no less than 10^{10} cells/g.

V. Acclimatization of Yeast Cells To the Gastric Environment

[0031] Because the yeast compositions of this invention must pass through the stomach before reaching the small intestine, where the effective components are released from these yeast cells, it is preferred that these yeast cells be cultured under acidic conditions to acclimatize the cells to the gastric juice. This acclimatization process results in better viability of the yeast cells in the acidic gastric environment.

[0032] To achieve this, the yeast powder containing activated yeast cells can be mixed with a highly acidic acclimatizing culture medium at 10 g (containing more than 10^{10} activated cells per gram) per 1000 ml. The yeast mixture is then cultured first in the presence of an alternating electric field having a frequency of 13092 MHz and a field strength of 360-390 mV/cm (e.g., 375 mV/cm) at about 28 to 32°C for 32 to 42 hours (e.g., 36 hours). The resultant yeast cells can then be further incubated in the presence of an alternating electric field having a frequency of 13123 MHz and a field strength of 260-280 mV/cm (e.g., 266 mV/cm) at about 28 to 32°C for 16 to 28 hours (e.g., 20 hours). The resulting acclimatized yeast cells are then dried and stored either in powder form ($\geq 10^{10}$ cells/g) at room temperature or in vacuum at 0-4°C.

[0033] An exemplary acclimatizing culture medium is made by mixing 700 ml fresh pig gastric juice and 300 ml wild Chinese hawthorn extract. The pH of the acclimatizing culture medium is adjusted to 2.5 with 0.1 M hydrochloric acid (HCl) and/or 0.2 M potassium hydrogen phthalate ($C_6H_4(COOK)COOH$). The fresh pig gastric juice is prepared as follows. At about 4 months of age, newborn Holland white pigs are sacrificed, and the entire contents of their stomachs are retrieved and mixed with 2000 ml of water under sterile conditions. The mixture is then allowed to stand for 6 hours at 4°C under sterile conditions to precipitate food debris. The supernatant is collected for use in the acclimatizing culture medium. To prepare the wild Chinese hawthorn extract, 500 g of fresh wild Chinese hawthorn is dried under sterile conditions to reduce water content ($\leq 8\%$). The dried fruit is then ground (≥ 20 mesh) and added to 1500 ml of sterilized water. The hawthorn slurry is allowed to stand for 6 hours at 4°C under sterile conditions.

The hawthorn supernatant is collected to be used in the acclimatizing culture medium.

VI. Manufacture of Yeast Compositions

[0034] To manufacture the yeast compositions of the invention, an apparatus depicted in Fig. 2 or an equivalent thereof can be used. This apparatus includes three containers, a first container (A), a second container (B), and a third container (C), each equipped with a pair of electrodes (4). One of the electrodes is a metal plate placed on the bottom of the containers, and the other electrode comprises a plurality of electrode wires evenly distributed in the space within the container to achieve even distribution of the electric field energy. All three pairs of electrodes are connected to a common signal generator.

[0035] The culture medium used for this purpose is a mixed fruit extract solution containing the following ingredients per 1000 L: 300 L of wild Chinese hawthorn extract, 300 L of jujube extract, 300 L of Wu Wei Zi (*Schisandra chinensis (Turez) Baill* seeds) extract, and 100 L of soy bean extract. To prepare hawthorn, jujube and Wu Wei Zi extracts, the fresh fruits are washed and dried under sterile conditions to reduce the water content to no higher than 8%. One hundred kilograms of the dried fruits are then ground ($\geq$20 mesh) and added to 400 L of sterilized water. The mixtures are stirred under sterile conditions at room temperature for twelve hours, and then centrifuged at 1000 rpm to remove insoluble residues. To make the soy bean extract, fresh soy beans are washed and dried under sterile conditions to reduce the water content to no higher than 8%. Thirty kilograms of dried soy beans are then ground into particles of no smaller than 20 mesh, and added to 130 L of sterilized water. The mixture is stirred under sterile conditions at room temperature for twelve hours and centrifuged at 1000 rpm to remove insoluble residues. To make the culture medium, these ingredients are mixed according to the above recipe, and the mixture is autoclaved at 121°C for 30 minutes and cooled to below 40°C before use.

[0036] One thousand grams of the activated yeast powder prepared as described above (Section V, *supra*) is added to 1000 L of the mixed fruit extract solution, and the yeast solution is transferred to the first container (A) shown in Fig. 2. The yeast cells are then cultured in the presence of an alternating electric field having a

frequency of 13092 MHz and a field strength of about 300-420 mV/cm (e.g., 397 mV/cm) at 28-32°C under sterile conditions for 36 hours. The yeast cells are further incubated in an alternating electric field having a frequency of 13123 MHz and a field strength of 310-330 mV/cm (e.g., 322 mV/cm). The culturing continues for another 12 hours.

[0037] The yeast culture is then transferred from the first container (A) to the second container (B) which contains 1000 L of culture medium (if need be, a new batch of yeast culture can be started in the now available first container (A)), and subjected to an alternating electric field having a frequency of 13092 MHz and a field strength of 420-460 mV/cm (e.g., 438 mV/cm) for 24 hours. Subsequently the frequency and field strength of the electric field are changed to 13123 MHz and 330-360 mV/cm (e.g., 348 mV/cm), respectively. The culturing continues for another 12 hours.

[0038] The yeast culture is then transferred from the second container (B) to the third container (C) which contains 1000 L of culture medium, and subjected to an alternating electric field having a frequency of 13092 MHz and a field strength of 310-340 mV/cm (e.g., 318 mV/cm) for 24 hours. Subsequently the frequency and field strength of the electric field are changed to 13123 MHz and 260-280 mV/cm (e.g., 272 mV/cm), respectively. The culturing continues for another 12 hours.

[0039] The yeast culture from the third container (C) can then be packaged into vacuum sealed bottles for use as dietary supplement, e.g., health drinks, or medication in the form of pills, powder, etc. If desired, the final yeast culture can also be dried within 24 hours and stored in powder form. The dietary supplement can be taken three to four times daily at 30-60 ml per dose for a three-month period, preferably 10-30 minutes before meals and at bedtime.

[0040] In some embodiments, the compositions of the invention can also be administered intravenously or peritoneally in the form of a sterile injectable preparation. Such a sterile preparation can be prepared as follows. A sterilized health drink composition is first treated under ultrasound (20,000 Hz) for 10 minutes and then centrifuged for another 10 minutes. The resulting supernatant is adjusted to pH 7.2-7.4 using 1 M NaOH and subsequently filtered through a membrane (0.22 μm for intravenous injection and 0.45 μm for peritoneal injection)

under sterile conditions. The resulting sterile preparation is submerged in a 35-38°C water bath for 30 minutes before use. In other embodiments, the compositions of the invention may also be formulated with pharmaceutically acceptable carriers to be orally administered in any orally acceptable dosage form including, but not limited to, capsules, tablets, suspensions or solutions.

[0041] The yeast compositions of the present invention are derived from yeasts used in food and pharmaceutical industries. The yeast compositions are thus devoid of side effects associated with many pharmaceutical compounds.

VII. Examples

[0042] The following examples are meant to illustrate the methods and materials of the present invention. Suitable modifications and adaptations of the described conditions and parameters which are obvious to those skilled in the art are within the spirit and scope of the present invention.

[0043] The activated yeast compositions used in the following experiments were prepared as described above, using *Saccharomyces cerevisiae* Hansen AS2.502 cells cultured in the presence of an alternating electric field having the electric field frequency and field strength exemplified in the parentheses following the recommended ranges listed in Section IV, *supra*. Control yeast compositions were those prepared in the same manner except that the yeast cells were cultured in the absence of EMFs. Unless otherwise indicated, the yeast compositions and the corresponding controls were administered to the animals by intragastric feeding.

Example 1: Effects of Yeast Compositions on Sexual Function of Castrated Male Wistar rats

[0044] To test the ability of the EMF-treated AS2.502 cells to improve male sexual function, hormone levels, and sexual organ development, 50 healthy adult male Wistar rats (about 100-120 g body weight, 6-8 weeks old) were selected. Ten rats were randomly selected to be the normal control group, CK1 (uncastrated rats). Under anesthesia with pentobarbital (5%, at 45 mg/kg body weight), both testes (including the epididymis) of each of the remaining 40 rats were removed under sterile conditions. Immediately after castration, Penicillin G was injected at 20,000 U/kg body weight once daily for five consecutive days. The castrated rats

were then randomly divided into four equal groups, designated as AY (for treatment with the activated yeast composition), NY (for treatment with the control yeast composition), CK2 (for treatment with testosterone propionate), and CK3 (for treatment with saline). Each rat was kept separately. The activated yeast composition was administered to the AY rats at 1.2 ml/kg body weight once daily for 30 days. The control yeast composition was administered to the NY rats and saline was administered to the CK3 rats at the same dosage. Testosterone propionate was injected intramuscularly to the CK2 rats in the buttocks at 2 mg/kg once daily for 30 days. The uncastrated CK1 rats, each also kept separately, were administered 1.2 ml/kg of saline once daily for 30 days.

[0045] On the twenty-ninth day of the experiment, two female rats (100-120 g, 6-8 weeks old) were put into the same cage as each male rat and kept there for 30 minutes. The frequency of the male rat's sniffing and licking of the female rats, and the frequency of the male rat's mounting of the female rats were recorded in Table 2.

[0046] Each male rat was sacrificed on the thirty-first day. The seminal vesicle and prostate were retrieved and placed in Bouin's solution overnight. The fatty tissue around the seminal vesicle and the prostate was removed. The ductus deferens, part of the urethra, and the bladder were also removed from the peripheries of the seminal vesicle and the prostate. The remaining seminal vesicle and the prostate were weighed and then submerged in 70% ethanol overnight. The urethra was then completely stripped away from the prostate and seminal vesicle. The wet weight of the prostate and seminal vesicle was recorded in Table 2. The oval-shaped glandulae preputiales was also retrieved from the pubis area. The wet weight of the glandulae preputiales was also recorded in Table 2.

Table 2. Effects of Yeast Compositions on Male Sexual Activity, Glandulae Preputiales, Seminal Vesicle and Prostate of Castrated Wistar Rats

Group (10 rats each)	Composition Used	Mounting Frequency Within a 30 min Period	Sniffing & Licking Frequency Within a 30 min Period	Glandulae Preputiales (mg)	Seminal Vesicle and Prostate (mg)
AY	activated yeast	16.7 ±2.3	38.7 ±4.1	93.7±18.6	303.8 ±44.3
NY	control yeast	4.2 ±1.4	8.6 ±3.4	48.6 ±11.4	51.6 ±23.4
CK1	saline	21.4 ±1.5	46.6 ±3.3	102.3 ±22.4	393.6 ± 78.3
CK2	testosterone propionate	12.3 ±4.6	22.7 ±4.6	89.5 ±14.6	198.7 ±42.6
CK3	saline	3.5 ±1.1	9.3 ±2.7	43.5 ±12.1	47.3 ±26.7

[0047] The results in Table 2 show that (1) the activated yeast composition was capable of restoring sexual function/activity in castrated male rats, while the control yeast composition or saline was not; (2) the activated yeast composition stimulated the growth of the prostate, seminal vesicle and glandulae preputiales in castrated rats, while the control yeast composition or saline did not; and (3) the activated yeast composition was superior to testosterone propionate in stimulating the growth of the prostate, seminal vesicle and glandulae preputiales.

<u>Example 2: Effects of Yeast Compositions on Erectile Function and Testosterone Levels of Castrated Wistar Rats</u>

[0048] To test the ability of the EMF-treated AS2.502 cells to improve male sexual function, hormone levels, and sexual organ development, 50 healthy adult male Wistar rats (about 150-180 g body weight, 8-10 weeks old) were selected. Ten rats were randomly selected to be the normal control group, CK1 (uncastrated rats). Under anesthesia with pentobarbital (5%, at 45 mg/kg body weight), both testes (including the epididymis) of each of the remaining 40 rats were removed under sterile conditions. Immediately after castration, Penicillin G was injected at 20,000 U/kg body weight once daily for five consecutive days. The castrated rats were then randomly divided into four equal groups, designated as AY (for treatment with the activated yeast composition), NY (for treatment with the control

yeast composition), CK2 (for treatment with testosterone propionate), and CK3 (for treatment with saline). Each rat was kept separately. The activated yeast composition was administered to the AY rats at 1.2 ml/kg body weight once daily for 30 days. The control yeast composition was administered to the NY rats and saline was administered to the CK3 rats at the same dosage. Testosterone propionate was injected intramuscularly to the CK2 rats in the buttocks at 2 mg/kg once daily for 30 days. The uncastrated CK1 rats, each also kept separately, were administered 1.2 ml/kg of saline once daily for 30 days.

[0049] On the thirty-first day of the experiment, an electrical stimulator was used to measure the erectile function of the rats. One of the two electrodes of the electric stimulator was placed at the opening of urethra, and the other in contact with the skin of the penis shaft. The stimulator was switched on at 55 Hz and 4.5 mA. The time needed for the penis to achieve erection ("the erection lag") was recorded in Table 3.

[0050] Each rat was sacrificed after the erection test. Blood samples were collected from each rat, and the blood concentration of testosterone was determined by the standard radio-immunoassay (RIA) method. The results are shown in Table 3 below.

Table 3. Effects of Yeast Compositions on Erectile Function and Testosterone Levels of Castrated Wistar Rats

Group (10 rats each)	Composition used	Erection Lag (second)	Testosterone Levels (ng/dl)
AY	activated yeast	18.7±10.2	138.72 ±64.15
NY	control yeast	28.2±14.5	58.66 ±23.43
CK1	saline	15.4±9.6	156.54±72.43
CK2	testosterone propionate	19.3 ±14.6	124.17 ±67.65
CK3	saline	27.5 ±15.4	49.38 ±22.76

[0051] The results in Table 3 show that the activated yeast compositions shortened erection lag and increased the secretion of testosterone, while the control yeast composition or saline did not.

[0052] While a number of embodiments of this invention have been set forth, it is apparent that the basic constructions may be altered to provide other embodiments which utilize the compositions and methods of this invention.